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Abortion Disease in Cattle

BY L. P. BEECHY
Specialist in Veterinary Medicine
Working cooperatively for the Ohio State University and the Bureau of Animal Industry of the United States Department of Agriculture

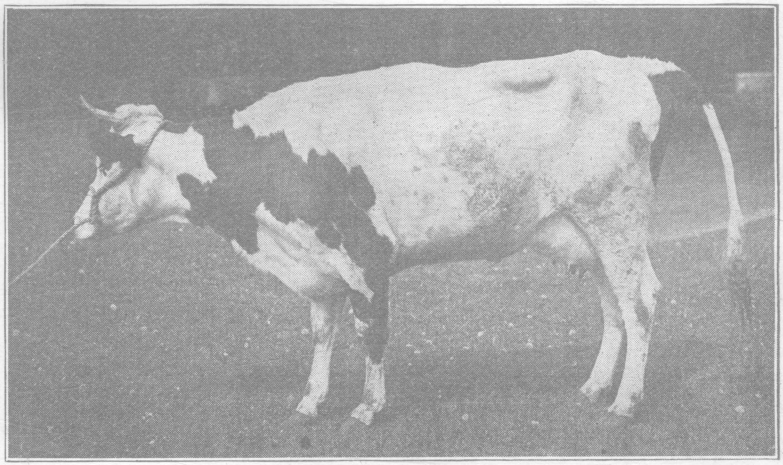

Fig. 1.—A neglected case of retained fetal membranes. Holstein heifer carried calf full time. Portion of fetal membranes retained, terminating in blood poison and death. (Pars. 30 and 58).

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INTRODUCTION

Abortion disease is a contagious disease causing tremendous losses to the cattle industry of Ohio.

Pure abortion disease is difficult to define and seldom found. More often it is complicated with various other disorders. A great majority of abortions are of the contagious type. Relatively few are due to accidents or other nonspecific causes. Such cases are known as sporadic abortion (63, 64, 65).

No specific cure of abortion disease has been discovered. Absolute eradication is hardly possible. Control measures that will greatly reduce losses are possible and practicable. They include:

Sanitary construction and maintenance of stables.

Frequent, systematic application of disinfectant sprays.

Isolation and treatment of infected cows.

Disposition of unprofitable cows for slaughter.

Retention of aborters otherwise profitable.

Replenishing herd by raising the heifer calves and control of breeding.

Proper feeds and feeding, with special attention to a well balanced ration, including the necessary mineral salts for the pregnant cow to insure a healthy, vigorous calf at birth.

The control of abortion disease demands hard, systematic work on the part of the owner and attendants in cooperation with and under direction of the attending veterinarian. A competent veterinarian should be employed in all cases to treat infected animals and the various complications that may arise. Avoid so-called special abortion antiseptics. The well known, standard varieties are efficient and less expensive.

Abortion Disease in Cattle

By L. P. Beechy

1. Various terms are applied to the act of expelling the fetus, such as slinking of the calf, miscarriage, premature birth, abortion, contagious abortion, infectious abortion, and abortion disease. The early recognition of the contagious character of the disease and the belief that the act of abortion was the sole phenomenon led breeders and veterinarians to apply the term "contagious abortion." Now that it is known that the act of abortion is the effect caused by the presence of disease and is not the disease itself, and, furthermore, that the disease may be present without causing abortion, but may be recognized by other symptoms and tests (34), the term contagious abortion is no longer desirable. It has a tendency to lead the owner to believe the disease is not present until abortion occurs. However, popular practice must be respected. Until a more satisfactory designation comes into general use the term "abortion disease" will suffice.

DEFINITION OF TERMS USED IN THIS BULLETIN

2. *Abortion,* the expulsion of the fetus before it has developed to the stage when it can be kept alive outside of the uterus; *fetus,* the unborn calf; *uterus,* womb; *fetal membranes,* afterbirth; *abortion bacillus,* the bacillus of Bang, the germ or infection regarded as the cause of abortion disease; *immunity,* ability to resist the cause of disease.

NATURE OF ABORTION DISEASE

3. Abortion disease is a chronic, infectious, and contagious disease of cattle, the principal, but not the only symptom of which is the death and expulsion of the fetus. The disease is chronic, requiring weeks and months to develop to the stage when it will produce visible symptoms. It is infectious, as it is regarded as being caused by a specific organism or infection. It is contagious, as it may be transmitted from animal to animal and herd to herd. It idious in that the general health of the animal apparently is not disturbed, and consequently its presence remains undiscovered for weeks and months. The average stock owner usually is not aware of the presence of disease until it is well established. The first abortion, if it is given any serious consideration, is usually attributed to an injury or to improper feeding. A retained afterbirth is generally regarded as little more than an annoyance. The neglect of such cases affords the best opportunity for the spread of the in-

fection to the remainder of the herd. Primarily it is a disease of the fetal membranes. It does not usually affect the general health of the cow, altho not infrequently, when neglected, complications set in which may cause serious injury and death.

The disease manifests its presence in different forms. Its onset may be sudden and severe, causing a large number of abortions. In another herd its progress is slow, with only an occasional abortion or possibly a retained afterbirth, but gradually increasing in virulence until the climax is reached in two, three, or four years. In still another herd, there may be no abortions, calves may be carried full term, but are born weak and soon die; or they may be born apparently healthy, but soon contract calf scours or calf pneumonia and die (29). In any case the disease leaves a trail of decreased milk production, dead calves, sterile cows, and cows which do not come in heat. Symptoms of the disease may disappear suddenly without any apparent reason or they may persist for years. Cows apparently acquire a certain degree of immunity (39) or the disease loses much of its virulency in course of time. In many herds known to be infected it is tolerated without manifestations of the usual symptoms.

PREVALENCE OF ABORTION DISEASE

4. Abortion disease is found in all parts of the United States, Canada, England, and continental Europe. Purebred and dairy herds are infected to a great extent. In recent years the disease has appeared in the beef herds of western ranges. Hardly a community in Ohio where cattle breeding or dairying is carried on to any considerable extent is entirely free of infected herds. No other disease of cattle is as prevalent under the varying conditions in which breeding animals are kept. The introduction of new mature stock into a herd without danger of also introducing the disease is becoming increasingly difficult. At present (1920) Ohio has no law controlling or restricting the sale and transportation of infected cattle. The purchaser must rely largely on the reputation of the seller as to his efforts in keeping his herd healthy. The purchaser is entitled to full information regarding the health of the herd from which he purchases stock. It is not enough for the seller to state he has had no abortions in his herd. He should also inform the purchaser of the occurrence of retained afterbirth, weak, underdeveloped calves, calf scours, and the presence of sterile cows in his herd.

THE LOSSES DUE TO ABORTION DISEASE

5. The first loss apparent to the owner is the calf which, nearly always, is born dead. If it is not dead at birth it is weakened to

such an extent that it soon dies. In purebreds and high grades the death of the calf constitutes a very serious loss. Another source of loss is that the milk flow is commonly decreased and frequently suspended for the time being. In cows aborting more than once, or in cows that become sterile, the milk flow may cease entirely. A nonmilker possesses only beef value and the beef value of a high-producing dairy cow is only a fraction of its value as a milk producer. A purebred cow whose value is determined by the quality of her offspring becomes a mere beef animal when her reproductive function ceases.

The cost of keeping and treating cows temporarily sterile constitutes another source of loss. Keeping permanently sterile cows for varying periods of time in vain efforts to restore their breeding efficiency is one of the most important factors in herd depreciation. Neglected cases of retained afterbirth frequently terminate in metritis, blood poison, and death of the cow. The close relation existing between abortion disease and such complicating disorders as calf scours, calf pneumonia, joint ill, and others must be taken into consideration in computing the losses.

6. Owing to a lack of data as a basis for calculation, nothing like an accurate estimate of the total animal losses sustained by cattle owners of Ohio is possible. Every author has his own method of computation, consequently there are always considerable variations in the estimates. The United States Department of Agriculture estimated the losses for the United States in 1914 as $20,000,000. Williams of Cornell University estimates the loss for New York state as $10,000,000. Surely different systems of computation must have been employed in compiling these estimates, for it is reasonably certain that New York state does not sustain half the losses in the United States. Hadley of Wisconsin bases his estimate on the assumption that 8 percent of all cows abort, each abortion representing a loss of $25, the value of the calf. On this basis he estimates the losses for Wisconsin at $3,570,000.

Reliable data have been obtained covering 772 cows comprising several highly developed purebred herds. All the cows were valuable and received the best of care and attention. Very careful records were kept. The depreciation of the herds was computed as follows:

Old age	1.0	percent
Accidents	1.5	"
Deaths	3.0	"
Abortion and complications	9.0	"
Total depreciation	14.5	percent

The average herd does not receive the expert care and attention these herds received, consequently the depreciations due to abortion disease are likely to be greater rather than less. Assuming, however, that 9 percent represents a fair average for Ohio herds, an approximate estimate can be made on this basis. The Ohio Department of Agriculture and the United States Bureau of Crop Estimates report 1,061,000 milch cows in Ohio January 1, 1920; total valuation $97,612,000. A depreciation of 9 percent due to abortion disease and its complications represents an aggregate annual loss of $8,785,080 to cattle owners of Ohio.

CAUSE OF ABORTION DISEASE

7. For many years stockowners and veterinarians looked upon abortion disease as a contagious disorder. In 1896 Professor Bang of Denmark discovered and isolated a micro-organism which, when administered to pregnant cows under suitable conditions, caused the animals to abort. Nearly all investigators have accepted the Bang bacillus as the cause of abortion disease. Frequently other organisms are present, but these are usually regarded as complications. Recently, Theobald Smith of the Rockefeller Institute announced his observations of several abortions in cows where the Bang bacillus could not be found. In place of the Bang organism he isolated another form of bacteria known as spirilli. However, so far there has been no evidence submitted to show that the spirillum will cause abortion when artificially administered. Until such fact is established the discovery of the presence of the spirillum should not be given undue importance.

The introduction of the Bang bacillus does not always result in abortion. A low degree of virulence may render the germ harmless until suitable conditions increase its virulence sufficiently to cause disease. This is the reason some animals may be infected long before showing any evidence of disease. Some cows possess a strong degree of resistance to the abortion germ. Altho they suffer no harm from the infection they may transmit the germ to other cows which are less resistant and more liable to contract disease. Many cows pass thru the most virulent outbreaks of abortion disease, calving normally at all times and showing no evidence of disease.

LOCATION OF ABORTION BACILLI

8. After gaining entrance into the body tissues of the cow the abortion bacilli locate themselves (a) in the pregnant uterus and (b) in the udder and associated lymph glands. In the non-pregnant cow they maintain themselves in the udder exclusively.

Schroeder and Cotton found that "when abortion bacilli are injected into the non-pregnant uterus of a cow, they disappear in the course of a few days." The same authors further state that "abortion bacilli injected into the veins of normal non-pregnant cows disappeared from the circulating blood in the course of a few hours; and when such cows were killed some time afterwards, the germs could not be found in their bodies unless it was in their udders and associated lymph glands." It is in the pregnant uterus where the disease-producing power of the abortion bacillus is manifested.

The discharges from an infected uterus, whether following abortion or full time parturition, are literally alive with abortion bacilli (10). Such discharges may remain infectious for from three to eight weeks. The infection has also been found in the digestive tract of the fetus. But in all such cases the fetal membranes and uterine discharges were infected. Once the udder is infected the milk becomes a possible agent in transmitting the disease to other cows (11). The infection probably remains active in the udder for years. Cooledge reports "in no instance has the udder infection died out after being firmly established during the three years that observations have been made."

CHANNELS OF ENTRANCE OF BACILLI INTO THE BODY

The channels of entrance of abortion bacilli into the animal body in the order of their importance are (a) the digestive tract, (b) the genital organs, and (c) possibly the milk ducts. Some writers reverse the order of the first two and assign first place to the genital organs. However, the order of their importance is not of so much consequence as the recognition of both in their relation to control measures.

9. The Digestive Tract.—Abortion germs gain entrance to the digestive tract with feed and water. Hay may become mixed with contaminated bedding, or the animal may feed on litter of stables and around straw stacks, soiled with discharge of an infected cow. Careless attendants may carry the infection on their hands and shoes, or on implements and utensils in such a way as to spread it to any or all of the different feeds. The germs may be carried into the digestive tract when the animal is turned into a recently infected pasture or by licking the external genitals of an infected cow. They are taken up by the circulation and deposited in the pregnant uterus or in the udder (8).

10. The Genital Organs.—Abortion germs may be deposited directly into the genital organs by the bull during service (17).

The external genitals may come in contact with bedding, manure, and other litter or with the tail soiled with contaminated material. Unsterilized instruments, thermometers and the hands of the operator may be the means of introducing the infection.

11. The Udder.—Schroeder and Cotton have demonstrated the possibility of infecting cows by the introduction of live abortion germs into the milk ducts. It is therefore regarded as possible that the infection may be accidentally introduced by the milker whose hands are soiled with infected milk (13) or by the udder becoming soiled with contaminated bedding.

MEANS OF SPREADING ABORTION DISEASE

12. The Uterine Discharges.—The most dangerous factor in the spread of abortion disease is the infected cow. The germs, being present in vast numbers in the uterine discharges, can be readily transmitted to other cows and herds. While an infected cow may transmit the disease at any time, she is most dangerous during the period she is discharging following abortion. A discharging cow will contaminate the stable, manure, bedding, and feed. Implements and utensils may become soiled with the objectionable discharge.

13. Milk.—Inasmuch as the udder is a favorite habitat of the abortion germ, the milk must be regarded as a source of infection. Skimmilk, buttermilk, and whey returned to farms from creameries, and cheese factories receiving milk from a number of dairies are almost certain to contain abortion germs. Such germs may be virulent or, under suitable conditions, become virulent when introduced into a herd. This is one reason, among several, why creameries should be required by law to pasteurize all milk and whey returned to farms, and sterilize the containers.

14. Attendants.—The disease may be transmitted thru the careless or ignorant habits of attendants and by the promiscuous use of utensils and implements which have become soiled with contaminated material. The germs may be conveyed on the clothing, especially shoes, and on the soiled hands of caretakers.

15. Pastures.—Pastures in which a discharging cow is kept remain dangerous to susceptible animals for varying lengths of time. The sun is a great destroyer of germ life. Abortion bacilli have a low resistance to direct sunlight and, when exposed, will soon die. Clean, sunny pastures harbor the infection only a short time after the discharging cow is removed, but the germs may remain alive indefinitely around old straw stacks, in the litter of sheds, and other damp, shaded places.

16. Calves.—Calves of infected cows, either aborted or born at full time, may be factors in the distribution of abortion disease. As a rule, calves do not harbor the infection long after the feeding of contaminated milk is discontinued. There seems to be a natural tendency on the part of calves to rid themselves of the infection. With an undeveloped udder and a non-pregnant uterus, calves possess no suitable habitat for the infection (8).

17. The Bull.—Most investigators regard the service bull as a disseminator of abortion disease. His genital organs becoming contaminated thru the act of copulation with an infected, discharging cow, he may transmit the infection directly into the genitals of the next healthy cow served. The abortion bacillus apparently causes no ill effects in the bull and disappears in the course of two or three weeks. Schroeder, Cotton, and Buck, have reported finding abnormal conditions associated with abortion bacilli in the sexual organs of only 7 bulls out of nearly 400 examined. Such a small percentage would indicate that abortion bacilli will cause harmful effects in the bull in only exceptional cases.

18. Reinfection.—If a cow aborts two or three times, it does not necessarily follow that all were due to the original infection. After the first abortion there may be an invasion of another set of a more virulent type of germs. Abortion disease has a tendency to die out. This is due either to the cows acquiring an immunity (39) or to the germs losing their virulence. The introduction of more virulent germs thru the purchase of mature cows from infected herds results in reinfection of the herd and probable repetition of abortions.

19. Stabling Conditions.—Abortion disease occurs in herds kept in stables built according to the latest approved plans of sanitary construction. This fact is made use of by those who affect to believe that the practice of sanitation does not inhibit the spread of the disease. It should be remembered, however, that a cow stable will not remain sanitary of itself regardless of its construction. The presence of the cows will render it insanitary unless it is kept clean and frequently sprayed or whitewashed. Furthermore, a stable of improper construction cannot be made sanitary. Many of the dairy cows in Ohio are overcrowded in insanitary stables with little or no provisions for ventilation. They are deprived of pure air, lowering their resistive power and exposing them to the various stable infections. Under such conditions the practice of efficient control measures is rendered much more difficult and the danger of complications is greatly increased.

20. Transmission to Other Farm Animals.—The transmission of abortion disease to other species of farm animals thru natural in-

fection occurs very rarely, if ever. The writer has made observations and investigations of numerous instances where brood sows were exposed to aborting cows for varying periods of time with no apparent ill effects. In one instance a group of cows, numbering from 17 to 32 during the period of observation, were isolated and quarantined on account of an extremely virulent outbreak of abortion disease. Brood sows had access to and occupied the barnyard with the infected cows, many of which were discharging. None of the sows aborted or showed any other ill effects during five years of observation. It should be noted, however, that occasionally abortions occur in mares, sows, and ewes after having been in contact with infected cows. But such occurrences are extremely rare, and it has not been established that they are caused by the Bang bacillus.

FACTORS SOMETIMES CONSIDERED IN THE SPREAD OF ABORTION DISEASE

21. Heredity.—Abortion disease is not inherited, altho the germ is frequently found in the digestive organs of calves of infected cows. Such infection, however, is brought about by the fetus swallowing placental fluid containing abortion germs (8). This does not, strictly speaking, constitute heredity.

22. Susceptibility of Breeds.—Other conditions being equal, all breeds of cattle appear to be equally susceptible. Dairy herds sustain by far the greatest losses, altho beef herds are by no means exempt. The apparent variations, sometimes noted, are due to difference in surroundings and methods of handling and not to the influence of breeds. Dairy cows are kept under artificial conditions. Crowded in stables, they afford ample opportunity for the rapid spread of infection. They are forced for maximum milk production while furnishing nourishment to the unborn calf. Cows kept under such environments naturally possess a lower degree of resistance to disease infection than those kept under more normal conditions.

23. Influence of Age.—Age does not exert any marked influence on the susceptibilities of cows to the infection, other conditions being equal. When the disease appears in a herd all breeding animals of any age are equally liable to become infected. In time most of the members of the herd acquire a certain degree of immunity. When such a condition prevails the manifestations of abortion disease is confined largely to heifers and young cows. This is probably the reason why, in some quarters, the belief is prevalent that the disease is more commonly found in young animals.

24. **Influence of Seasons.**—There is no evidence that either seasons or weather conditions exert any perceptible influence upon the occurrence of abortion disease. The increased number of abortions during the winter and early spring is due to the common breeding practice of having cows become fresh in the springtime.

THE FETAL STRUCTURES

25. In order that there may be a clearer understanding as to the manner in which abortion bacilli cause the death and expulsion of the fetus as well as other abnormal conditions frequently observed, a little study should be given to the connection between the fetus as it is suspended in the uterus, and the mother. The fetus is surrounded by three membranes or coverings, one within the other. These constitute the afterbirth. The first membrane, amnion, contains a fluid in which the fetus is suspended. At time of birth this fluid amounts to from four to six quarts. A second membrane, allentois, only partially surrounds the fetus. It is a double membrane and between its folds holds a quantity of fluid which in the later stages of pregnancy is composed principally of fetal urine. This constitutes the water bag. At full time parturition the quantity of fluid amounts to from ten to fourteen quarts. Surrounding all the foregoing structures is the third membrane, chorion, the outer surface of which comes in contact with the wall of the uterus. The outer surface of the chorion presents numerous cauliflower-like tufts of greatly thickened folds of membrane with corresponding depressions or crypts. These are the fetal cotyledons and number from 60 to 90. They are oval in shape, from two to four inches in length and one to two inches in width. They are red in appearance, the surface being covered with a network of very small blood vessels or capillaries. The capillaries unite, forming larger blood vessels; this process is repeated until they are united into two main trunks—the umbilical vein and umbilical artery—which penetrate into the fetus thru the navel. The lining membrane of the uterus presents a number of tufts known as maternal cotyledons similar in structure to that of the fetal cotyledons. The membranous folds of one fit in between the folds of the other, bringing the two into intimate contact, but there is no actual attachment between the two. The blood of the fetus is purified and receives nutritive elements from the maternal circulation thru the capillaries of the cotyledons. It carries oxygen and nourishment to the fetus thru the umbilical vein. The impure blood is returned to the cotyledons thru the umbilical artery. The maternal circulation never enters the fetus and the fetal circulation never enters the mother. In this manner the life of the fetus is maintained. Any disturbance

of the intimate contact between the maternal and fetal circulations results in depriving the fetus of its required amount of nourishment.

HOW GERMS PRODUCE ABORTION

26. As already stated, the abortion germs have a tendency to locate themselves in the pregnant uterus. Here they set up an inflammation of the chorion, causing a separation of the fetal from the maternal cotyledons. As the inflammation spreads, more of the cotyledons become involved, their ability to transmit nourishment to the fetus is interfered with or destroyed, and the calf dies. Nature does not tolerate the presence of a dead calf in the womb, consequently the calf is expelled, which constitutes abortion.

If the infection is of a virulent type or occurs early in pregnancy, abortion results. If the infection is mild or occurs late in pregnancy the inflammation may not have had sufficient time to spread over an area sufficiently large to cause the death of the fetus. In that case the calf is carried full time but is born weak and soon dies. In some the inflammation is of such a nature as to cause a swelling of the cotyledons, causing them to adhere more firmly instead of separating; in such a case the calf may be carried full time, but parturition is followed with retention of the afterbirth. When a strong resistance to the germ exists, the calf may be carried full time, be born apparently healthy, and the cow clean herself properly altho infection may be present. In such a case, as well as in all the others mentioned above, the uterine discharges, the afterbirths, and the newly born calves are heavily infected and may be the means of transmitting infection to other susceptible animals.

PERIOD OF INCUBATION

27. We refer to the time elapsed between the entrance of the germ into the animal body and the occurrence of abortion as the period of incubation. This depends upon the severity of the infection and the resistance of the animal. When the virulence of the germs is low and the degree of resistance of the cow is high, the period is prolonged. When the virulence of the germ is high, the infection heavy, and the resistance of the cow is low, or, when all three conditions are present, the period of incubation is short. These variations in the virulence of abortion germs, degrees of infection, and resisting powers of cows account, in a large measure, for the different types of abortion disease.

PERIOD OF PREGNANCY IN WHICH ABORTION IS MOST LIKELY TO OCCUR

28. Abortion may occur at any stage of pregnancy. Most observed abortions occur during the fifth, sixth, and seventh months.

Many take place earlier and some later. In the early months of pregnancy the fetal membranes are expelled with the fetus. Such abortions frequently escape observation, and the cow is believed to be sterile. Heifers commonly abort earlier in pregnancy than older cows. The time of abortion depends upon the virulence of the germ, the degree and time of infection, and the power of resistance on the part of the cow (27).

COMPLICATIONS

29. The most common complications are retained afterbirth and sterility. The former may terminate in the latter or the two may occur independently of each other. Mammitis (inflammation of the udder), metritis (inflammation of the uterus), diseased ovaries, and septicemia or blood poison, constitute a group of disorders usually associated with abortion disease. Other closely related disorders frequently found in infected herds are calf scours, calf pneumonia, and navel ill.

30. **Retention of Afterbirth.**—When the calf is born it has no further use for the fetal membranes. In normal calving they are expelled in a short time. If they are retained more than three or four hours it is an indication that some abnormal or unhealthy condition is present. Retention of the afterbirth is almost universally regarded by scientists as a manifestation of abortion disease. It is a more serious problem than it is believed to be by most stock owners. It affords a channel for the entrance of numerous other germs that give rise to a variety of diseases. The membranes soon become infected with the germs of decomposition and putrefaction sets in. The womb at such times is highly sensitive to the action of disease germs. Inflammation of the womb (metritis) occurs, followed by a repulsive putrid discharge which not infrequently results in blood poison and death if proper treatment is not applied. The inflammation may subside and the cow recover, but there remains an unnatural condition of one or more of the generative organs, which leaves the cow sterile.

31. **Sterility.**—As heretofore noted, one of the chief sources of loss in abortion disease is the failure of cows to conceive or to come in heat. Some cows become chronic bullers. In any event their breeding function is suspended or destroyed. Sterility may occur following an abortion, a retained afterbirth, or in heifers which have never calved. Many cases of sterility are found in cows which had retained afterbirth, and which were not given proper treatment. Shreds of membrane remaining in the uterus will cause metritis (29). The lining membrane of the uterus is altered in structure or destroyed according to the extent and severity of the inflamma-

tion. The deeper tissues may become involved, resulting in a thickened, hardened condition of the uterine walls rendering the cow permanently sterile (Fig. 2). In others the ovaries become diseased. The conditions present and the causes operating to prevent conception can be determined only by a careful physical examination of the parts by a competent veterinarian who has had training and experience in that line of work.

The question of sterility is an intricate one, and is not fully understood. Most investigators believe that abortion bacilli do not directly cause it but that they bring about a condition which makes

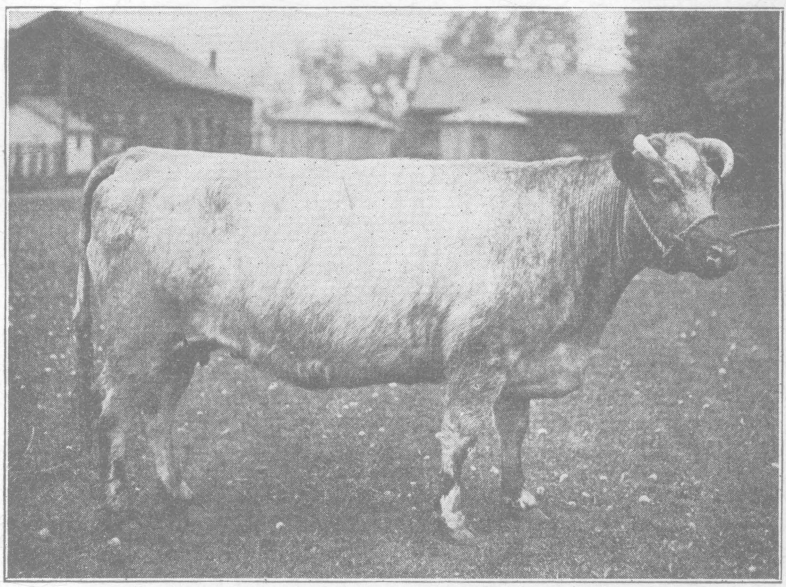

Fig. 2.—Shorthorn cow carried first calf full time. Developed chronic metritis and is now permanently sterile. (Par. 31).

it possible for other disease germs to enter and cause lesions which destroy the breeding functions. A majority of sterile cows respond to treatment. The expense attached to a course of treatment of an ordinary grade cow is, in most cases, probably not justified. Treatment of valuable purebred and high-producing grade cows is always desirable where a diagnosis has been made and the possibility of successful treatment is indicated.

32. The frequent occurrence of sterility in virgin heifers raises the question of its relationship to abortion disease. No authoritative answer to that question is available. It is certain, however, that a systematic course of treatment by one trained in that line of

work will, in many cases, result in the proper functioning of the reproductive organs.

33. Sterility may exist independently of abortion disease due to various causes such as nervous disorders, lack of development, and malformation or disease of one or more of the reproductive organs.

SYMPTOMS OF ABORTION DISEASE

34. Usually the first symptom evident to the owner is the act of abortion. To be on the safe side the owner should regard it as an indication of the presence of the disease. Possibly the owner may recall that during the previous season one or two cows may have had retention of the afterbirth, or he may have experienced difficulty in breeding one or more cows. When abortion occurs during the later months of pregnancy, the usual symptoms preceding normal calving, such as making bag, swelling of the external genitals, dropping of the rump, and a white mucus-like discharge are observed. In such abortions retention of afterbirths frequently occur. A characteristic brownish discharge follows which persists for two, three or more weeks if the animal is not given proper treatment. In rare instances the dead calf is not expelled but remains in the womb where it undergoes decomposition and the womb becomes filled with putrefactive material. The absorption of poisonous products from the uterine contents in such cases may cause the death of the mother.

Abortions in the early stages of pregnancy occur without showing any preliminary symptoms. Frequently the fetus with its membranes are expelled in pastures or out-of-the-way places where they remain unobserved. The cow remains in apparent perfect health and abortion is not suspected.

DIAGNOSIS OF ABORTION DISEASE

35. Diagnosis is the recognition of a disease by its symptoms, history, appearances of lesions, bacteriological examinations, or certain biologic tests. The presence in the herd of sterile cows, retained afterbirth, weak, underdeveloped calves, and uterine discharge with or without abortion is considered good diagnostic evidence of abortion disease. A careful examination of the fetal membranes is an aid to diagnosis. The healthy cotyledons are easily recognized by their live red color. When diseased they possess a dead brown color combined with more or less pus either on their surface or in the crypts between the membranous folds. Correct diagnosis is essential to intelligent preventive and control measures. Demonstration of abortion bacilli is usually not practical under field conditions.

36. **Abortin Useless as a Test Agent.**—In order that quicker and more accurate diagnosis may be had, attempts have been made to produce an artificial diagnostic agent as reliable as the tuberculin test for tuberculosis. Experiments with this substance, known as abortin, have shown it to be worthless for the purpose intended.

37. **Blood Tests and Their Limitations.**—Two kinds of blood tests are in use—the agglutination test and the complement fixation test. The former is fully as accurate as the latter and more convenient. Tests must be made in the laboratory with samples of blood from suspected animals. A detailed description of the tests is not deemed necessary. They are based on the well known fact that where disease germs invade the animal body certain substances—antibodies—are formed in the blood and tissues. The purpose of the antibodies is to neutralize the poisons eliminated by the germs and thereby throw off the disease. They persist in the blood a long time after the germs have disappeared. The blood tests show the presence or absence of antibodies. They do not indicate the presence of abortion germs.

38. Blood tests serve a useful purpose as diagnostic agents, but their limitations must be clearly recognized. Inasmuch as a reaction from a blood test indicates the presence of antibodies but does not indicate the presence of abortion germs, it can readily be understood that its use will only show that the reacting cow is or was infected. It does not indicate that the cow has aborted or that it will abort. It does not indicate that the animal will spread infection or that it will not do so. When applied to a herd, a positive test will indicate the presence of true abortion disease. It will also show the extent of the infection in the herd by indicating the members of the herd which have been infected. The agglutination test is valuable in the detection of herd infection and the extent of the infection in the herd.

IMMUNITY TO ABORTION DISEASE

39. Immunity is the power to resist disease. Cattle possess a natural immunity against some diseases such as glanders and cholera. An acquired immunity is one brought about when an animal has recovered from a disease and is no longer susceptible to it. The immunity persists as long as sufficient antibodies remain in the blood. The presence of antibodies, therefore, is some evidence of immunity. It is quite well established that some cows possess a natural immunity to abortion disease, while in others the immunity is acquired. The nature and extent of immunity in abortion disease is not well defined and appears to be somewhat irregular. It may be said, as a rule, that a slow-developing chronic disease confers a

low degree of immunity, if any, while an acute disease establishes a high degree of immunity.

PREVENTION OF ABORTION DISEASE

40. Medicines Not Wholly Effective.—The thoughts of the owner of a clean herd are rightfully centered on efficient methods of prevention. The owner of an infected herd is interested in measures which will keep the disease under control and in the application of such treatment of individual animals as will keep the losses to a minimum. It must be clearly understood that there is no reliable, short cut cure. Many medicinal remedies have been tried, among them carbolic acid and methylene blue, but none have been found efficient. By a little study of the nature of the disease it is plain why the use of drugs internally can have little or no effect on it. Antiseptics are useful when properly applied. The liberal use of disinfectants is highly recommended. The standard official varieties are more reliable and cheaper than the exploited proprietary remedies.

41. Prevention of Herd Infection.—The ideal method of combating abortion disease is the prevention of herd infection. The widespread distribution of the disease, together with the constant interchange of cattle for breeding and dairying purposes, renders this anything but an easy task. However, prevention is easier than cure and far more effective. Stables should be well lighted and ventilated. They should be located where good drainage is possible, and constructed in such a manner that good sanitation may be maintained. Write to the College of Agriculture, the Ohio State University, for information on construction of cow barns. Frequent and regular spraying with a standard disinfectant solution is absolutely necessary (52).

The disease is usually introduced by the purchase of new stock. The introduction of mature stock to a herd is extremely dangerous unless the purchaser is sure it comes from clean herds. If any doubt exists, the animals should be kept in separate quarters until that point can be determined. When it is necessary to introduce new blood it is safer to purchase calves or young heifers before they have been bred. Calves from infected herds do not retain the infection any great length of time, while a mature cow having acquired an immunity may remain an infection carrier for many months. If it is necessary to breed to an outside bull, the greatest care should be exercised to ascertain that the one selected is free of infection and that he has been properly treated. A herd bull should not be permitted to serve outside cows unless they are known to be clean.

Should there be any doubt in the matter, the bull should be carefully treated (60). A better practice is to keep an extra bull for community service. Adequate preventive measures may be deemed inconvenient, but the protection afforded a good herd amply repays the owner for his trouble.

CONTROL OF ABORTION DISEASE

42. Once infection appears in a herd, efficient control must be depended upon to keep losses to a minimum. Complete eradication is hardly possible with our present limited understanding of the disease. That the disease can be controlled to such a degree as to reduce losses to a negligible quantity has been demonstrated in numerous instances. But it requires patience, perseverance and long continued hard work to carry on all the necessary sanitary measures. Control work is particularly suitable in valuable purebred or producing herds. Such a herd may be temporarily unprofitable, but it may again be made efficient by the exercise of careful herd management and the treatment of affected animals.

43. The most important factors in herd management as affecting the control of abortion disease are

1. Giving immediate attention to all symptoms.
2. Providing sanitary quarters.
3. Control of breeding activities.
4. Retention of heifer calves.
5. Retention in the herd of otherwise profitable cows.
6. Herd immunity.
7. Isolation of aborting cow.
8. Proper disposition of fetus and its membranes.
9. Disinfection of quarters.
10. Attention to feeding.

44. **Giving Immediate Attention to All Symptoms.**—On the first appearance of any symptoms, measures should be taken immediately to prevent the infection being transmitted to the other members of the herd. An abortion or a retained afterbirth always should be regarded as an indication of abortion disease and should be treated accordingly. If it develops later that the symptoms were due to other causes, no harm will result from the precautions taken. On the other hand, if the matter is neglected and it proves to be abortion disease, as it does in a large majority of cases, the infection is likely to spread to every animal in the herd.

45. **Use of Sanitary Quarters.**—The advantages of sanitary stable construction and maintenance are apparent. A dark, damp,

filthy, and unventilated stable provides suitable conditions for the harboring of infection. A light, dry, clean, and well ventilated stable is an enemy of germ life. A maximum amount of sunlight is of the greatest importance because it destroys germ life. Sanitary construction does not necessarily imply elaborate, expensive barns. Satisfactory barns can be built at moderate cost.

46. **Control of Breeding.**—A bull running with the herd may be the means of disseminating infection within the herd. An infected cow frequently becomes a "chronic buller," affording every opportunity for the bull to carry infection to healthy cows. Bulls

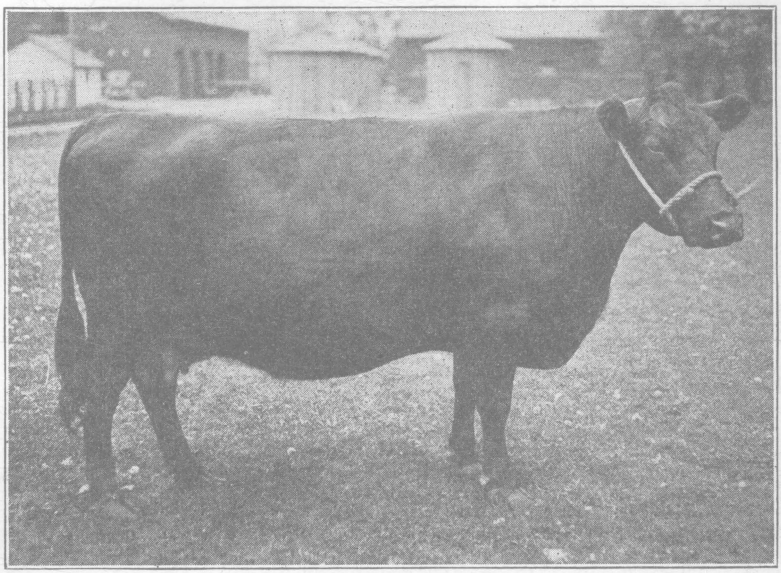

Fig. 3.—Angus cow aborted her first calf. Has since raised seven healthy calves. (Par. 48).

should be permitted to serve only uninfected cows or cows which have been successfully treated. Restricting the service of the bull to healthy cows is more effective in preventing dissemination of infection than the practice of irrigating the bull's sheath (60) with antiseptic solutions, altho, in many cases, the latter practice is absolutely necessary.

47. **Retention of Heifer Calves.**—As far as possible an infected herd should be maintained and built up by raising the heifer calves. There are good reasons to believe that calves from infected cows which have recovered are less likely to abort when mature than calves from clean herds brought on an infected premises. Experi-

ments have shown that calves infected at birth later throw off the infection and in doing so many acquire a certain degree of immunity. Experience with large herds has demonstrated that control measures are most effective where heifer calves were retained.

48. **Retention of Profitable Cows.**—A cow otherwise profitable should not be disposed of because she aborted. About 80 percent of aborting cows abort only once (Figs. 3 and 4); only a small percent abort the third time. By careful handling and expert treatment most of them can be made to breed successfully. If cows are sold they must usually be replaced by the purchase of others.

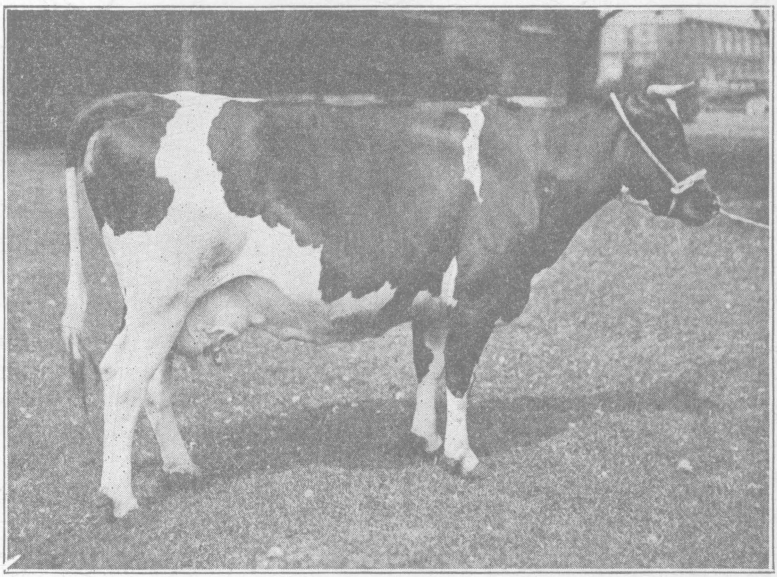

Fig. 4.—Holstein cow produced 515 pounds butterfat during her first milking period. Aborted once. Calved normally since. (Par. 48).

If they are from clean herds they are more susceptible than those which have passed thru the disease; if from an infected herd they may introduce a more virulent type of the disease, causing a reinfection of the herd. Unprofitable cows should be sold for slaughter.

49. **Herd Immunity.**—The tendency of abortion disease is to run its course and gradually subside unless new, susceptible animals are introduced into the herd. The part that immunity plays in abortion disease is not thoroly understood. It cannot be said that a herd becomes absolutely immune, but practical experience has clearly established the fact that a herd will acquire a degree of immunity or tolerance of the disease not possessed by it when the

disease first appeared. Establishing a so-called herd immunity can be accomplished by expert treatment of aborting cows and raising heifer calves instead of replenishing a herd by the purchase of mature cows. The establishment of herd immunity is a very effective method of reducing losses in infected herds. Not infrequently the disease abates as quickly as the onset was sudden. The herd again becomes profitable and the losses insignificant.

50. **Isolation of Aborting Cow.**—A cow that has aborted, or a cow that shows signs of aborting (34), or a cow that has retained her afterbirth for more than four hours (30), should be immediately separated from the others and confined in quarters where she can be kept under strict quarantine. The discharging cow is objectionable in a dairy herd. Even when indications point to a general herd infection, she should be removed in the interest of sanitary milk production. The attendant should exercise the greatest care in order to avoid carrying the infection on his hands, utensils, implements, and shoes to the well members of the herd. Isolation quarters must be completely separated and so arranged that drainage from them will not contaminate the herd stable. A separate barn is preferable. The quarantined cow should not be restored to the herd until all signs of discharge have disappeared. No attempt to breed her should be made before the expiration of two weeks after the disappearance of the discharge. The maintenance of regular maternity stalls for all cows during the calving period is a very good practice. The stall should be carefully cleaned and sprayed with a good disinfecting solution, and clean bedding provided after one cow is removed and before another is admitted.

51. **Disposition of Fetus and Fetal Membranes.**—The aborted fetus and its membranes, together with the uterine discharge, are swarming with abortion germs. No system of prevention is efficient which does not make provision for the proper disposition of these products. If possible the calf and its membranes should be destroyed by burning. If this is not feasible, they should be buried deeply, first covering with lime. Manure and litter contaminated with uterine discharge should be spread upon fields to which cattle will not have access during the season.

52. **Disinfection of Stables.**—The destruction of germ life in infected stables thru the application of powerful disinfectants is absolutely essential in all efforts to control infectious diseases. The effective application of disinfectants is not possible unless the premises have been prepared by the removal of all manure, litter, and refuse; the ceilings, sidewalls, and pillars cleaned of all cob-

webs and accumulated dust; and the floors, mangers, and troughs cleaned of every particle of filth. A badly worn wooden floor should be replaced. After the stable has been properly prepared the disinfecting solution should be applied to the entire interior until all parts are wet. A spray pump, hose, and nozzle furnish the best means of applying the solution. The use of the standard well known disinfectants is recommended. A very efficient as well as economical disinfectant is composed of 1 part cresol compound to 30 parts water. This is especially recommended for the maternity stalls and all parts of the stable where infected cows had been kept. For general use in the dairy barn there is some objection to the odor. For such purpose a whitewash of rock lime freshly slaked and prepared is satisfactory if regularly and frequently applied. If a cow aborts in the herd, her stall and the adjoining stalls should immediately be cleaned and the cresol solution applied. All the litter should be removed and burned.

53. **Attention to Feeding.**—The general health, condition, and power of resistance to disease are governed to a considerable degree by the kind and amount of feed and the time and methods of feeding. The pregnant cow should be well fed on a ration containing all the elements necessary for her own nourishment, for the growth and development of the calf, and for the production of milk. Attention to the mineral content of feeding rations and drinking water is important and often overlooked. Whenever indications point to a lack of sufficient mineral ingredients, provision should be made to supply them. Bulletins on feeds and feeding may be obtained free by writing to the College of Agriculture Extension Service of the Ohio State University, and the Ohio Agricultural Experiment Station, Wooster, Ohio. An excellent mineral mixture can be made up by the stock owner to be fed as a supplement to the regular ration.

Powdered wood charcoal	10 pounds
Wood ashes	10 pounds
Salt	8 pounds
Air-slaked lime	8 pounds
Sulphur, powdered	4 pounds
Copperas	2 pounds

Mix thoroly and give heaping tablespoon on feed twice a day.

TREATMENT OF ABORTION DISEASE

54. Treatment of infected cows is essentially the work of a trained veterinarian. But the intelligent owner can be very helpful. Upon him depends, to a great extent, the degree of success

that may be attained in efforts to restore the usefulness of infected cows. Negligence and improper treatment have resulted in tremendous losses to owners, much of which might have been averted. To treat cows successfully requires intelligent cooperation between the veterinarian and the owner. The veterinarian must have a thoro knowledge of the anatomy and physiology of the reproductive organs, together with an understanding of the pathology of the disease. The owner should be able to administer such supplemental treatment as is indicated, under the direction of the veterinarian. The purposes underlying treatment are essentially (a) to prevent the dissemination of disease germs, and (b) to prevent or cure complications. Success of preventive treatment depends almost entirely upon the owner. If he is careful, energetic, and persistent in the application of treatment as set forth in this bulletin and in cooperation with a competent veterinarian, losses will be greatly reduced.

55. A brief outline of the reproductive organs of the cow may be helpful to a clearer understanding of remedial measures. The external or visible part is the vulva. In front of this is a rather large cavity called the vagina. In the forward part of the vagina is the "cervix" or neck of the uterus. Next to the neck is the body of the uterus, which, in the non-pregnant state, is quite short and terminates in the two long horns of the uterus. The fallopian tubes are attached to the ends of the horns, connecting them with the ovaries and affording a passageway for the ovum or egg from the ovaries to the uterus. Normally the neck of the uterus is quite hard and the opening extremely small and twisted. This fact has misled many owners into the belief that failure to breed was due to the cow not being "open." Sometimes owners will attempt to relieve the supposed abnormal condition by forcibly inserting a sharp piece of wood. This is a dangerous practice and may result in serious injury to the cow. The condition is normal, and any attempt to dilate the canal should be done by an expert equipped with the proper instruments for the purpose of applying treatment.

In the early stages of pregnancy the uterus begins to increase in size. The opening is sealed with a plug of mucus. The uterus continues to enlarge as the fetus develops. During calving the neck expands to an enormous degree. After calving it contracts and again resumes its normal condition unless it is kept open by a retained afterbirth. If a part of the afterbirth is entirely within the uterus, the neck will close and imprison the putrefying contents. If not relieved at once by proper treatment, this condition will develop into septic metritis, accompanied by severe straining

and an exceedingly offensive discharge, terminating in sterility, or in blood poisoning and death of the cow (Fig 4). During the time the opening is dilated, it is an easy matter to insert the hand or a soft rubber tube for the purpose of removing the afterbirth and flushing the uterus.

56. **Douching.**—Flushing out the uterus is a treatment not easily applied except during the time the opening is dilated soon after calving. Only a trained man equipped with the proper instruments should attempt it. Douching the vagina is an operation that can be applied by any intelligent herdsman who follows instructions. The object in douching the uterus is to wash out all foreign material, prevent inflammation, and to assist that organ to resume, more quickly, its normal function. The vaginal douche keeps the parts clean and prevents contamination from outside sources. Utmost care should be exercised by the operator to prevent dissemination of infection by means of his hands and instruments. Instruments should be sterilized by boiling and then immersed in an antiseptic. The hands should be thoroly cleaned and washed in an antiseptic. Sterilization of hands and instruments should precede each treatment. Vaginal douching should be repeated daily, semi-weekly, or weekly, as directed by the attending veterinarian. After discharge has ceased the rear end of the cow, including the tail, should be well scrubbed with a good disinfecting solution. Two weeks later the cow may be bred. Douching the vagina with salt solution just before breeding is highly desirable.

57. **Antiseptic Solutions.**—Mild antiseptic solutions are often recommended for flushing out the genitals. Strong solutions should never be used, as their injection into the uterus will irritate the parts and cause violent straining. Many of the most successful operators do not make use of antiseptics for douching, but depend upon normal salt solution and its cleansing properties when used in large quantities. Even the mildest antiseptic solutions must be drawn off and followed by flushing with the salt solution, otherwise the parts will become irritated, causing excessive straining. The normal salt solution is recommended as effective and the least likely to produce bad results. All douching preparations should be as warm as the hand will stand. The following is a list of a few of the more common preparations in use for douching.

Normal salt solution—2 level teaspoons to 1 quart boiled water.
Permanganate of potash—1 teaspoon to 1 quart water.
Lugol's solution of iodine—1 tablespoon to 3 pints water.
Cresol Compound or Lysol—1 tablespoon to 3 quarts of water.

For external use in disinfecting the tail and rear parts of the cow the solutions should be three times the strength indicated above.

58. **Treatment for Retained Afterbirth.**—The nature, cause, and the serious consequences which often follow retained afterbirth have been stated. Proper treatment is important. Drugs cannot be depended upon. The membranes must be removed, but force should never be employed. As a rule it is better not to attempt to remove them for 48 hours after calving. Any attempts for the first two days should be confined to heavy flushing with warm salt solution. During this time the uterus is usually so large that the attachments in the forward portion cannot be reached. Furthermore, the attachments to the cotyledons are difficult to separate. Later the uterus is smaller, all parts can be reached, and the cotyledons are more easily separated. When possible, especially in the case of valuable cows, an experienced veterinarian should be employed. When this is not practicable the owner or attendant may do the work, but the greatest care must be exercised to avoid injuring the cow. The operator should be equipped with 6 feet of ½-inch soft rubber tubing, to one end of which a funnel is attached. An injection pump is more satisfactory, as the solution can be forced to all parts of the uterus. There is little danger of the pressure rupturing the uterus if it has not been otherwise injured. After the hands and arm of the operator, the tube, and the hind parts of cow have been carefully washed and disinfected, the tube is inserted into the uterus as far as possible. Covering the end of the tube with the hand while introducing it will avoid danger of lacerating the parts. The other end is elevated well above the cow and the warm solution poured into the funnel by an assistant. If an injection pump is used the assistant operates it. The membranes are now carefully detached from the cotyledons one by one with the thumb and fingers much as a garment is unbuttoned. It is not uncommon for a novice to pinch off the cotyledons. The result is the cow dies of hemorrhage. Pulling on the membranes must be avoided, as they are easily torn. It is well to be systematic, separating all the attachments as you go in order to avoid missing any of them. It is important to remove every shred of membrane or the purpose of the operation is defeated. After the membranes have been removed the fluid is siphoned off by lowering the outer end of the tube. Fresh solution is injected and withdrawn, completing the operation. Irrigation of the uterus and vagina is repeated once daily until discharge ceases.

59. Treatment of Complications.—Treatment of the various complicating and closely related diseases, such as mammitis, metritis, septicemia, sterility, calf scours, calf pneumonia, and navel ill, is not within the scope of this bulletin. Such diseases require the services of competent veterinarians. The treatment indicated in this bulletin is to prevent, as far as possible, such complications. Sanitation, and the liberal and systematic use of disinfectants will greatly reduce the losses from the many complex disorders incident to abortion disease. Sterility can be treated successfully in a majority of the cases. Valuable cows should not be sold for slaughter until a competent veterinary examination has confirmed the sterility to be incurable.

60. Treatment of the Bull.—A bull standing for public service may transmit disease. To prevent such transmission of disease (17) requires special treatment before and after each service. The long hairs of the prepuce are clipped. A ½-inch soft rubber tube is inserted about 5 inches and is held in place by drawing the skin of the sheath tightly over it with the hand. This will also prevent the escape of the fluid. The other end of the tube with funnel attached is elevated above the animal and the disinfecting fluid poured in by an assistant. With his free hand the operator thoroly massages the sheath for two or three minutes, forcing the fluid to every part. Permanganate of potash solution constitutes an excellent preparation for this purpose (57). A strong solution irritates the parts, the bull becomes intractable and difficult to handle, and the application of the treatment difficult and hazardous.

61. Serums, Bacterins and Vaccines.—The fact that many cows acquire a certain degree of immunity after infection has led investigators to attempt to bring about immunity by the use of various biologic products such as serums, bacterins and vaccines. These terms are not synonymous, but too often they are loosely applied to the same product. They represent three distinct products and should not be confused. **Serum** is the defibrinated blood of an immunized animal. **Bacterins** are the killed bacteria or germs artificially grown, together with the products of their growth. **Vaccines** are the living disease-producing germs.

Experiments have not shown serums and bacterins to possess any virtue in abortion disease. The claims of many commercial houses engaged in the production and sale of these products cannot be said to be justified. So-called guarantees are meaningless, and stock owners should not allow themselves to be misled. Abortion disease is a disease of so many complexities that it is usually

difficult to arrive at any conclusion as to the value of a remedy except thru a long series of experiments with accurate checks. Consequently a guarantee to refund the price of serums and bacterins if not satisfactory will not protect the owner against loss. Bacterins, being composed of dead bacteria, can do no harm. In the absence of well authenticated and carefully controlled experiments showing beneficial results their usefulness as immunizing agents cannot be recommended.

62.—Experiments with living virulent abortion germs have proven slightly more encouraging. Reports of some investigators indicate that the use of vaccines resulted in reducing the number of observed abortions, but it is not stated what influence, if any, vaccines have on the occurrence of retained afterbirth, sterility, and the consequent losses in reproduction. In the absence of definite information relative to the actions of vaccines upon the various other manifestations of abortion disease, aside from the act of abortion, the evidence of their usefulness in general practice is not very convincing.

Vaccines may be useful in developing herd immunity, but the owner should have a clear understanding that they are as yet in the experimental stage. Too much should not be expected of them. Being composed of living abortion germs they should never be used in a clean herd or on pregnant animals. Their use should be confined to herds already infected and to heifers and non-pregnant cows at least two months before breeding. Abortion vaccines in the hands of an inexperienced novice may cause much harm to the cattle industry of a community.

SPORADIC ABORTION

63. Sporadic abortions are single and exceptional occurrences of abortion not due to any specific organism. They are neither contagious nor infectious. Such abortions are brought about by various causes, which for all practical purposes, may be summarized as follows:

1. Mechanical injury sufficiently severe to cause death of the fetus.
2. The result of an acute febrile disease.
3. The presence in the feed of plants containing drugs which exert specific action on the uterus, or plants affected with certain fungous diseases.
4. Improper feeding—keeping cows on rations deficient in one or more ingredients necessary for the growth and development of the fetus.

64. **Diagnosis of Sporadic Abortion.**—Abortion resulting from any of the four causes enumerated (63) may, as a rule, be readily differentiated from the infectious type. An injury may be the result of an animal falling heavily, being kicked by a horse, or gored by other cattle. The fetus, however, is so well protected by nature that an external injury severe enough to cause abortion would, in all probability, leave well marked evidence of its presence. Therefore, an abortion should not be attributed to injury unless unmistakable evidence of injury can be observed.

Abortion, the result of an acute disease accompanied by high fever, may be recognized by the presence of the disease. The absence of an acute disease indicates the abortion is due to some other cause. Cases of the above two types occur singly and usually take place during the more advanced stages of pregnancy.

The third cause of sporadic abortion is met with most frequently in the form of ergot poisoning. Ergot is a fungoid disease of some plants, particularly rye. It has a powerful action on the uterus and when present in the feed may cause a number of abortions. Abortions from ergot poisoning occur within a relatively short period of time. The onset of the trouble is sudden, severe, and ends abruptly. Ergot poisoning may be recognized by the presence of well marked symptoms other than abortion.

The fourth cause—the result of improper nutrition of the fetus—is due, in most cases, to deficiency in minerals. It is well known that young, growing animals require a larger proportionate amount of minerals in the feed than do mature animals. Minerals

are absolutely necessary for the development of bone and other tissues. They exert an energizing influence on the vital processes, increasing bodily strength and vigor. Absence of the required amount of mineral salts interferes with the normal development of the fetus, and may cause its death and consequent expulsion. If death does not occur the fetus is weakened, rendering it more susceptible to the influences of other causes, including abortion bacilli.

65. Prevalence of Sporadic Abortions.—In former years sporadic abortions were believed to be the most common. Only occasional outbreaks in the larger herds were looked upon as belonging to the infectious type. Further study has convinced investigators that abortions of sporadic origin are exceedingly rare and of small economic importance as compared to those caused by abortion bacilli. Further reference to them is deemed unnecessary.

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